Big Five facets' associations with pro-environmental attitudes and behaviors

Received: 7 April 2020 | Revised: 22 June 2020 | Accepted: 3 July 2020

DOI: 10.1111/jopy.12576

ORIGINAL MANUSCRIPT

WILEY

Big Five facets' associations with pro-environmental attitudes and behaviors

Alistair Raymond Bryce Soutter[1] | **René Mõttus**[1,2]

[1]Department of Psychology, University of Edinburgh, Edinburgh, UK

[2]Institute of Psychology, University of Tartu, Tartu, Estonia

Correspondence
Alistair Raymond Bryce Soutter, University of Edinburgh, 7 George Square, Edinburgh EH89JZ, UK.
Email: alsoutter@gmail.com

Funding information
University of Edinburgh

Abstract

Climate change mandates us to understand why individuals do (not) behave pro-environmentally and personality traits are well suited for this purpose. Past research has mostly focused on how broad domain-level personality traits were associated with pro-environmental attitudes and behaviors. In two datasets ($N = 501$ and 287), we examined whether personality facets provided a more detailed picture of how personality traits were associated with pro-environmental attitudes and behaviors. It was found that some facets were the main drivers of domain-level associations. Furthermore, it was found that facets, collectively, predicted pro-environmental attitudes ($r = .50$ to $.52$) and behaviors ($r = .29$ to $.42$) in holdout datasets. This predictive ability was on par with the predictive ability of domains. Therefore, facets provided a greater understanding of how personality traits were associated with pro-environmental attitudes and behaviors. Furthermore, facets provided a similar predictive ability of pro-environmental attitudes and behaviors to that of domains.

KEYWORDS

Big Five, environmentalism, facets, personality, prediction

1 | INTRODUCTION

Conservation psychology aims to (a) understand why people do (not) behave in a pro-environmental manner and (b) identify ways to promote pro-environmental behaviors (Clayton & Brook, 2005). Within conservation psychology, there are two main variables of interest: pro-environmental attitudes and behaviors. Pro-environmental attitudes can broadly be defined as one's tendency to exhibit favor toward the natural environment (Hawcroft & Milfont, 2010; Milfont, 2007). Pro-environmental behaviors are concrete actions (including not taking an action), whether deliberate or not, that positively impacts the natural environment (Soutter, Bates, & Mõttus, 2020).

Previous research had identified several variables that were associated with pro-environmental attitudes and behaviors. For example, an early meta-analysis identified cognitive variables, such as knowledge of the environment or environmental issues, as being meta-analytically associated with pro-environmental behaviors ($r = .30$; Hines, Hungerford, & Tomera, 1987). In this meta-analysis several psycho-social variables were also found to be moderately to strongly associated with pro-environmental behaviors: pro-environmental attitudes ($r = .35$), locus of control ($r = .37$), economic orientation ($r = .16$), personal responsibility ($r = .33$), and verbal commitment ($r = .49$). Lastly, it was found that demographic variables were weakly to moderately associated with pro-environmental behaviors: gender ($r = .08$), age ($r = -.15$), income ($r = .16$), and education ($r = .19$).

A later meta-analysis (Bamberg & Möser, 2007) examined similar variables in association with pro-environmental

behaviors. The cognitive variable of knowledge was re-defined as problem awareness and had a weaker association with pro-environmental behaviors than had been found earlier ($r = .19$). However, other variables such as pro-environmental attitudes ($r = .42$), perceived behavioral control ($r = .30$; re-named locus of control), moral norm ($r = .39$; re-named personal responsibility), and intention ($r = .52$; re-named verbal commitment) were associated with pro-environmental behaviors similarly to the previous meta-analysis. This meta-analysis did not address the demographic variables of gender, age, income, and education but found that social norms ($r = .31$), feelings of guilt ($r = .30$), and internal attribution ($r = .24$) were associated with pro-environmental behaviors.

These meta-analyses identified personality traits as being associated with pro-environmental behaviors, but focused on a few specific personality traits (e.g., locus of control, economic orientation, and personal responsibility). Subsequent research has also considered broader domains of personality.

1.1 | Personality and conservation psychology

Personality research has become increasingly involved in conservation psychology (e.g., Hirsh, 2010, 2014; Klein, Heck, Reese, & Hilbig, 2019; Markowitz, Goldberg, Ashton, & Lee, 2012; Milfont & Sibley, 2012; Soutter et al., 2020). Within this growing body of research, an increasing number of studies have used the broad personality domains of the Big Five/Five-Factor Model (referred to throughout as Big Five; Goldberg, 1990; McCrae & John, 1992) and the HEXACO (Ashton & Lee, 2007). It was demonstrated that pro-environmental attitudes and behaviors were robustly associated with the domains of Honesty-Humility, and Openness, and to a smaller extent Agreeableness, Conscientiousness, and Extraversion (Soutter et al., 2020). Collectively, the Big Five domains predicted pro-environmental attitudes and behaviors in independent samples with an accuracy around $r = .28$ to .45 (Soutter et al., 2020).

However, the Big Five and HEXACO domains constitute only one level of the personality trait hierarchy. Each of these domains can be split into facets. Although the exact structure of facets is still debated and authors have proposed different solutions (e.g., Ashton & Lee, 2007; Condon, 2018; Soto & John, 2017), the 30-facet solution implemented in the Revised NEO Personality Inventory (six for each Big Five domain; NEO-PI-R; Costa & McCrae, 1992) has been widely used. Facets contain a substantial amount of unique information about how people differ in personality, above and beyond the domains under which they are subsumed (e.g., Elleman, Condon, Holtzman, Allen, & Revelle, 2020; Elleman, McDouglad, Condon, & Revelle, 2020; Mõttus, 2016; Mõttus & Rozgonjuk, 2019; Paunonen & Ashton, 2001; Vainik et al., 2019).

1.2 | Benefits of facet-level associations

There are two primary benefits to examining facet-level associations, as opposed to domain-level associations, when examining how personality traits are associated with other variables. First, by examining facet-level associations, researchers can understand more specifically which facets within a domain are driving its associations. For example, Openness has been found to be positively associated with pro-environmental attitudes and behaviors (Soutter et al., 2020), but it is yet unclear if this generalizes to all of Openness' facets (Puech, Dougal, Deery, Waddell, & Mõttus, 2019). If the association only pertains to a selection of facets, it is inappropriate to interpret associations at the domain-level (Mõttus, 2016). It is even possible that some facets of, say, Neuroticism are positively associated, and others negatively associated with pro-environmental attitudes and behaviors; they would cancel out at a domain-level, resulting in no overall association between Neuroticism and pro-environmental attitudes and behaviors (Soutter et al., 2020). Practically speaking, having a more detailed knowledge of what exactly it is within any given personality domain that drives its association with pro-environmental attitudes and behaviors, could potentially be translated into more efficiently targeted interventions. For example, by focusing specifically on facets that are associated with pro-environmental attitudes and behaviors as opposed to those that are not.

Another possible benefit of examining how personality is associated with pro-environmental attitudes and behaviors at a facet-level may be increased out-sample predictive power (i.e., prediction of the outcome in people not used in mapping out the associations in the first place; Yarkoni & Westfall, 2017). Soutter and colleagues (2020) demonstrated that pro-environmental attitudes and behaviors could be out-sample predicted from the Big Five domain scores. Research in other areas, such as age and obesity, have shown that facets provided even greater predictive ability (Mõttus & Rozgonjuk, 2019; Vainik et al., 2019). This has not yet been tested for pro-environmental attitudes or behaviors.

1.3 | Existent facet-level findings

Compared to research on domains, there have been fewer studies on facet-level associations, but the studies that have been conducted found that certain facets, indeed, drive the domain-level associations. Some studies have found that facets of the same domains were consistently associated with pro-environmental behaviors (Brick & Lewis, 2016), while others had found the opposite, which might explain a lack of an association at the domain level (Markowitz et al., 2012).

Specifically, the facets of Openness generally tend to have the strongest associations with pro-environmental attitudes and behaviors (Markowitz et al., 2012). Among these facets, those that describe aesthetic appreciation tend to have the most consistent and strongest associations (Brick & Lewis, 2016; Diessner, Davis, & Toney, 2009; Klein, 2015; Markowitz et al., 2012; Puech et al., 2019). It is thus possible that greater aesthetic appreciation of nature motivates a desire to preserve the environment (e.g., Hirsh & Dolderman, 2007). Another aspect of Openness that has appeared to be consistently associated with pro-environmental attitudes and behaviors is intellectual curiosity (Boeve-de Pauw, Donche, & Van Petegem, 2011; Brick & Lewis, 2016; Markowitz et al., 2012). It is perhaps a drive for knowledge as well as a greater understanding of humanity's impact on nature that pushes people to be pro-environmental. However, research suggested that the unconventionality aspect of Openness was only associated with pro-environmental attitudes and not pro-environmental behaviors (Brick & Lewis, 2016).

Among the facets of Agreeableness, those associated with empathy and altruism, have been suggested to be the most important facets in driving Agreeableness' associations with pro-environmental attitudes and behaviors (Markowitz et al., 2012). Indeed, environmental change may take a long time or even never impact those who contributed to the environmental issue. Thus, taking actions that might be costly to one's self may require an element of empathy for future generations, other animals, or even the wider environment (Soutter et al., 2020). However, past research on these facets had been inconsistent. For example, Markowitz and colleagues (2012) found no consistent associations with the facets of Agreeableness and pro-environmental attitudes, as measured by the New Ecological Paradigm. In contrast, Klein (2015) found that altruism and tendermindedness were consistently associated with pro-environmental workplace motivations. Irritability, dominance, and egocentrism facets had been shown to be negatively associated with pro-environmental attitudes (Boeve-de Pauw et al., 2011).

The facets of Conscientiousness also vary in their associations with pro-environmental attitudes and behaviors (Klein, 2015; Markowitz et al., 2012). For example, facets to do with perseverance and self-discipline might be positively associated with pro-environmental attitudes and behaviors, as enacting environmental behaviors requires a persistent repetition of environmental behaviors across time and situations (Boeve-de Pauw et al., 2011; Brick & Lewis, 2016; Markowitz et al., 2012; Pettus & Giles, 1987). In contrast, facets to do with the order have been found to be less consistently associated with pro-environmental attitudes and behaviors (Markowitz et al., 2012; White & Hyde, 2012).

The HEXACO model also includes the domain of Honesty-Humility, which is associated with the domains of Agreeableness and Conscientiousness in the Big Five (Ashton & Lee, 2020; Lee, Ashton, Choi, & Zachariassen, 2015). Facets that tap greed avoidance had been shown to be positively associated with pro-environmental attitudes and behaviors (Brick & Lewis, 2016; Markowitz et al., 2012). This makes sense as the current ecological crisis can be accounted for by the exploitation of natural resources by humanity. Furthermore, caring for others and indeed the wider environment is unlikely to fit with a self-focused personality.

Last, the facets of Neuroticism and Extraversion had been inconsistently associated with pro-environmental attitudes and behaviors (e.g., Boeve-de Pauw et al., 2011; Brick & Lewis, 2016; Markowitz et al., 2012). For example, the socially orientated facets of Extraversion were associated with pro-environmental behaviors but were not consistently associated with pro-environmental attitudes (Brick & Lewis, 2016). Facets assessing warmth and positive emotions were also associated with pro-environmental motivations (Klein, 2015). It might be that Extraversion is associated with pro-environmental attitudes and behaviors when these attitudes and behaviors have a more socially rewarding aspect to them or involve socially acting within the environment (e.g., nature walks and outdoor sports).

1.4 | Present study

This study aimed to explore whether facets provided a more detailed picture of how pro-environmental attitudes and behaviors were associated with personality traits, above and beyond the Big Five domains. Based on prior research in this area (Soutter et al., 2020) we expected that the domain of Openness would have the strongest association with pro-environmental behaviors, with somewhat weaker associations for the domains of Agreeableness, Conscientiousness, and Extraversion, and no significant association for the domain of Neuroticism. But we predicted that facet-level associations would vary within domains, although mostly in their strength rather than direction. Given the possibility that the associations of personality with pro-environmental behaviors are at least partly mediated by pro-environmental attitudes, we expected that the personality correlates of pro-environmental attitudes to be similar to pro-environmental behaviors in configuration, but stronger in magnitude. This is because attitudes are then more proximal to personality traits than behaviors. We examined the associations in two separate samples using somewhat different measures of pro-environmental behaviors, allowing us to cross-validate the findings.

Our second aim examined whether facet-level information provided a greater out-sample predictive ability of pro-environmental attitudes and behaviors, compared to domain-level information. For this, we trained the prediction model in one sample and applied it in the other to test the accuracy of the predictions.

2 | METHOD

Two existing datasets were used. For both, data collection had been approved by a research ethics committee and participants provided informed consent. Both datasets can be found as supplementary materials to this article on the Open Science Framework (https://osf.io/6c37n/?view_only=26cf482b7241440898e70a3f57ceb353; Soutter & Mõttus, 2020).

2.1 | Participants

The first dataset (Dataset A; Soutter & Mõttus, 2019) consisted of 501 participants, including 304 females (60.7%), 195 males (38.9%), and 2 "Other" gender choices (0.4%), with a mean age of 40.4 (SD = 12.3). Participants were exclusively from the United Kingdom and were recruited via the Prolific platform. Participants received financial compensation for their participation.

The second dataset (Dataset B; Soutter, Bates, & Mõttus, 2019) consisted of 287 participants, 207 females (72.1%), and 80 males (27.9%), with a mean age of 27.2 (SD = 11.2). Participants were recruited via Prolific, with financial compensation for their participation, or via a first-year psychology undergraduate sample pool, with course credit for their participation. Participants from the first-year psychology undergraduate sample pool were located in the United Kingdom; however, there was no restriction on location for the participants recruited via Prolific.

2.1.1 | Effect size and power

As mentioned in section 1.4 we expected similar effect sizes for domain-level associations, as those found in Soutter and colleagues (2020), and that facet-level associations would vary within domains, although mostly in their strength rather than direction. With some facets demonstrating stronger associations than their domains, and others weaker associations. We aimed to maximize statistical power and rigor through cross-validations across samples and by conducting a meta-analysis across our two samples. A post hoc power analysis revealed that with our combined sample (N = 788), using a critical α = .002, and a power of .80, we were able to detect correlations of r = .14.

2.2 | Measures

2.2.1 | Personality

Participants in both datasets completed a 120-item personality questionnaire from the International Personality Item Pool (IPIP-NEO-120; Johnson, 2014). This scale was designed to mimic the structure of the NEO-PI-R in measuring the Big Five domains as well as their 30 facets, using four items per facet.

2.2.2 | Pro-environmental attitudes

Participants in both datasets completed three pro-environmental attitudes measures. The New Ecological Paradigm (Dunlap, Van Liere, Mertig, & Jones, 2000), a 15-item measure, required participants to rate their agreement with items on a 5-point Likert scale with the responses 1 (*Strongly Disagree*), 2 (*Mildly Disagree*), 3 (*Unsure*), 4 (*Mildly Agree*), and 5 (*Strongly Agree*), α = .73 to .87. The Connectedness to Nature Scale (Mayer & Frantz, 2004), a 14-item measure, required participants to rate their agreement with items on a 5-point Likert Scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*), α = .84 to .88. The Environmentalism Scale (Soutter, 2020), a 38-item measure, required participants to rate their agreement with items on a 5-point Likert scale with the responses 1 (*Strongly Disagree*), 2 (*Somewhat Disagree*), 3 (*Neither agree nor disagree*), 4 (*Somewhat Agree*), and 5 (*Strongly Agree*), α = .93 to .96. These measures had all demonstrated good test-retest reliability (r = .55 to .86), internal consistency (α = .86 to .96), and predictive validity of pro-environmental behaviors (r = .41 to .56) in a previous study (Soutter, 2020).

2.2.3 | Pro-environmental behaviors

Participants in both datasets completed a donation measure (Soutter & Boag, 2019). Participants indicated how they would split $/£100 between three charities (one being an environmental charity), and the option of keeping the money for themselves.

In Dataset A the Pro-Environmental Behavior Scale (PEBS; Markle, 2013), a 19-item scale with four subscales (conservation, environmental citizenship, food, and transport), was used, α = .37 to .87. The original rating system was used, except that the driving question was given two additional responses. These were "I do not drive" (scored as the most environmental response) and "I do not know" (scored as the least environmental response). Last, the Environmental Behavior measure (EB), a 17-item measure, of which only 14 items were used due to a previous factor analysis (Soutter, 2020), was used. Participants rated how frequently they performed the presented behaviors on a 5-point Likert scale, with the responses of 1 (*Never*), 2 (*Sometimes*), 3 (*About half the time*), 4 (*Most of the time*), and 5 (*Always*), α = .81. The item that asked participants if they drove a fuel-efficient car had the additional option of 6 (*Do not own a car*; scored

as the most environmental response). In Dataset B participants completed a 10-item future behaviors measure (Soutter et al., 2019). In this measure, participants reported how likely they were to perform 10 behaviors in the future on a 5-point Likert scale with the responses of 1 (*Extremely unlikely*), 2 (*Somewhat unlikely*), 3 (*Neither likely nor unlikely*), 4 (*Somewhat likely*), and 5 (*Extremely likely*), $\alpha = .79$.

The PEBS had been shown to be a reliable and valid measure (Markle, 2013). The EB had demonstrated concurrent validity with existing measures of pro-environmental behaviors (Soutter, 2020), and in this study demonstrated concurrent validity with the four subscales of the PEBS ($r = .31$ to $.57$, $p < .001$). The donation measure demonstrated concurrent validity with the conservation and environmental citizenship subscales of the PEBS ($r = .19$ to $.22$, $p < .001$). Last, the future behaviors measure in Dataset B demonstrated concurrent validity with the donation measure ($r = .45$, $p < .001$).

2.3 | Statistical analyses

All analyses were completed in R version 3.6.1 (R Core Team, 20192019), and the script for these analyses can be found on the Open Science Framework (https://osf.io/6c37n/?view_only=26cf482b7241440898e70a3f57ceb353; Soutter & Mõttus, 2020). First, as we were concerned with how domains and facets were associated with pro-environmental attitudes and behaviors rather than individual scales (Mõttus, 2016), combined pro-environmental attitudes and behaviors scores were created, respectively. This was done by standardizing each of the pro-environmental attitudes (or behaviors) measures, and then taking an average of this to create a total pro-environmental attitudes (behaviors) score. This was done separately in each dataset.

To describe the associations between personality and pro-environmental attitudes and behaviors at a domain- and facet-level, correlations were calculated in each sample separately. To estimate the robustness of these findings, the associations between domains and pro-environmental attitudes in Dataset A were correlated with the associations between domains and pro-environmental attitudes in Dataset B ($N = 5$). This was repeated for pro-environmental behaviors, as well as for facet-level associations with both outcomes ($N = 30$). If the findings were consistent across datasets, meta-analytic associations would be calculated, with correlations weighted by the inverse of their standard errors combined; and we would focus our interpretations on the meta-analytic findings. In aggregate, this process would achieve our first aim of understanding if facet-level information provided a greater understanding, compared to domain-level information, of how personality traits were associated with pro-environmental attitudes and behaviors.

To achieve our second aim of understanding if facet-level information also provided a greater predictive ability of pro-environmental attitudes and behaviors, we performed two predictive analyses (Mõttus & Rozgonjuk, 2019). The first analysis multiplied the correlations between domains or facets and pro-environmental attitudes or behaviors calculated in one of the samples by the respective standardized personality scores (domains or facets) in the other sample, to create predicted (from domains or facets) pro-environmental attitudes or behaviors scores. These predicted scores were then correlated with actually measured pro-environmental attitudes and behaviors scores. This process was repeated swapping the samples around. The second analysis, used a more sophisticated but less tractable approach, were domains' and facets' predictive power for pro-environmental attitudes and behaviors were tested with linear elastic net regression via the *glmnet* package (Friedman, Hastie, Simon, & Tibshirani, 2019); both outcomes were linked with either domains or facets in one sample (with 10-fold cross-validation and shrinkage parameter that minimized prediction error) and the models were applied in the other sample to test their accuracy (i.e., correlations between predicted and observed outcome values).

3 | RESULTS

3.1 | Association patterns

The pattern of associations between domains and pro-environmental attitudes were consistent across datasets ($r = .97$, $p = .005$), as were the associations between facets and pro-environmental attitudes ($r = .83$, $p < .001$). Likewise, the pattern of associations between domains and pro-environmental behaviors were consistent across datasets ($r = .94$, $p = .018$), and the same applied to facets and pro-environmental behaviors ($r = .70$, $p < .001$). We also estimated the consistency of the effect sizes of facet-level associations across samples net of differences between the Big Five domains (subtracting the domain-wide average effect sizes from the facets' effect sizes; we did this because differences in domains were confounded with differences between facets in how they were correlated with pro-environmental attitudes and behaviors): the 30 facet-attitude associations correlated at $r = .62$, $p < .001$ across samples, whereas the facet-behavior associations correlated at $r = .47$, $p = .009$. Due to the relatively good replicability of the patterns of associations across datasets, meta-analytic associations were calculated for them and will be described below.

Pearson correlations between domains and pro-environmental attitudes and behaviors, and between facets and pro-environmental attitudes and behaviors can be found in Table 1, alongside the meta-analytic associations across our two samples. See Figures 1 and 2 for a summary of these meta-analytic associations. These correlations used a nominal

TABLE 1 Associations between personality domains, facets, and pro-environmental attitudes and behaviors

	Dataset A ($N = 501$)		Dataset B ($N = 287$)		Meta-analytic coefficients	
	Attitudes [95% CI]	Behaviors [95% CI]	Attitudes [95% CI]	Behaviors [95% CI]	Attitudes [*SE*]	Behaviors [*SE*]
D: Neuroticism	−.02 [−.10; .07]	−.11† [−.19; −.02]	.02 [−.10; .13]	−.05 [−.16; .07]	−.01 [.04]	−.09† [.04]
F: Anxiety	−.01 [−.10; .08]	−.10† [−.19; −.02]	.12† [.01; .24]	.03 [−.09; .14]	.04 [.04]	−.05 [.04]
F: Anger	−.06 [−.15; .03]	−.11† [−.20; −.02]	−.06 [−.18; .06]	−.08 [−.20; .03]	−.06 [.04]	-.10† [.04]
F: Depression	.00 [−.08; .09]	−.04 [−.13; .05]	.06 [−.06; .17]	.06 [−.06; .17]	.02 [.04]	−.00 [.04]
F: Self-consciousness	.03 [−.05; .12]	−.07 [−.15; .02]	−.02 [−.14; .09]	−.06 [−.18; .06]	.01 [.04]	−.07 [.04]
F: Immoderation	−.04 [−.13; .05]	−.14* [−.22; −.05]	−.04 [−.16; .07]	−.14† [−.25; −.02]	−.04 [.04]	−.14** [.04]
F: Vulnerability	−.00 [−.09; .09]	−.02 [−.11; .07]	.03 [−.08; .15]	−.02 [−.13; .10]	.01 [.04]	−.02 [.04]
D: Extraversion	.08 [−.01; .16]	.16** [.08; .25]	.02 [−.09; .14]	.04 [−.07; .16]	.06 [.04]	.12** [.04]
F: Friendliness	.03 [−.06; .11]	.12† [.03; .20]	.04 [−.08; .16]	.01 [−.11; .12]	.03 [.04]	.08† [.04]
F: Gregariousness	-.04 [−.12; .05]	.07 [−.01; .16]	−.03 [−.15; .08]	.00 [−.12; .12]	−.04 [.04]	.04 [.04]
F: Assertiveness	.01 [−.08; .10]	.06 [−.03; .14]	.05 [−.06; .17]	.06 [−.05; .18]	.02 [.04]	.06 [.04]
F: Activity level	.08 [−.01; .17]	.15** [.06; .23]	.07 [−.05; .19]	.13† [.01; .24]	.08† [.04]	.14** [.04]
F: Excitement seeking	.12† [.03; .20]	.14† [.05; .22]	−.04 [−.15; .08]	−.01 [−.13; .11]	.06 [.04]	.09† [.04]
F: Cheerfulness	.16** [.07; .24]	.18** [.10; .26]	.01 [−.10; .13]	.00 [−.11; .12]	.11† [.04]	.12* [.04]
D: Openness	.47** [.40; .53]	.40** [.33; .47]	.45** [.35; .54]	.26** [.15; .36]	.46** [.03]	.35** [.03]
F: Imagination	.26** [.18; .34]	.14† [.05; .22]	.20** [.08; .31]	.03 [−.08; .15]	.24** [.03]	.10† [.04]
F: Artistic interests	.41** [.33; .48]	.38** [.30; .45]	.39** [.28; .48]	.29** [.18; .39]	.40** [.03]	.35** [.03]
F: Emotionality	.29** [.20; .36]	.18** [.10; .27]	.35** [.24; .45]	.13† [.02; .25]	.31** [.03]	.16** [.04]
F: Adventurousness	.12† [.03; .20]	.19** [.11; .28]	.17† [.05; .28]	.20** [.09; .31]	.14** [.04]	.19** [.04]
F: Intellect	.33** [.25; .40]	.32** [.24; .40]	.33** [.22; .43]	.19* [.08; .30]	.33** [.03]	.27** [.03]
F: Liberalism	.36** [.29; .44]	.32** [.23; .39]	.17† [.05; .28]	.05 [−.07; .16]	.30** [.03]	.23** [.03]
D: Agreeableness	.34** [.26; .41]	.28** [.20; .36]	.33** [.23; .43]	.20** [.09; .31]	.34** [.03]	.25** [.03]
F: Trust	.09 [−.00; .17]	.14* [.05; .23]	−.05 [−.16; .07]	−.10 [−.22; .01]	.04 [.04]	.05 [.04]
F: Morality	.22** [.14; .31]	.16** [.08; .25]	.33** [.22; .43]	.21** [.10; .32]	.26** [.03]	.18** [.04]
F: Altruism	.35** [.27; .42]	.25** [.16; .33]	.33** [.23; .43]	.13† [.01; .24]	.34** [.03]	.21** [.03]
F: Cooperation	.17** [.08; .25]	.16** [.07; .24]	.17† [.06; .28]	.13† [.02; .24]	.17** [.04]	.15** [.04]
F: Modesty	.08 [−.00; .17]	.07 [−.01; .16]	.21** [.10; .32]	.18* [.07; .29]	.13** [.04]	.11* [.04]
F: Sympathy	.46** [.38; .52]	.35** [.27; .42]	.37** [.26; .46]	.24** [.13; .35]	.43** [.03]	.31** [.03]
D: Conscientiousness	.14* [.05; .23]	.18** [.09; .26]	.19* [.07; .29]	.17† [.06; .28]	.16** [.04]	.18** [.04]
F: Self-efficacy	.13† [.04; .22]	.14* [.05; .22]	.14† [.03; .26]	.09 [−.03; .20]	.13** [.04]	.12** [.04]
F: Orderliness	.07 [−.01; .16]	.14* [.06; .23]	.05 [−.07; .16]	.11 [−.01; .22]	.06 [.04]	.13** [.04]
F: Dutifulness	.18** [.10; .27]	.12† [.03; .20]	.15† [.04; .26]	.13† [.01; .24]	.17** [.04]	.12** [.04]
F: Achievement striving	.19** [.10; .27]	.20** [.12; .28]	.25** [.13; .35]	.20** [.08; .31]	.21** [.03]	.20** [.03]
F: Self-discipline	.08 [−.00; .17]	.15** [.07; .24]	.10 [−.01; .22]	.15† [.03; .26]	.09† [.04]	.15** [.04]
F: Cautiousness	−.03 [−.11; .06]	−.00 [−.09; .09]	.09 [−.03; .20]	.04 [−.07; .16]	.01 [.04]	.01 [.04]

Abbreviations: D, domain; F, facet.

$^{\dagger}p < .05$; $^{*}p < .002$; $^{**}p < .001$.

alpha of .002 for statistical significance to correct for multiple comparisons.

Among the domains, Openness was the most strongly associated with pro-environmental attitudes and behaviors ($r = .46$ and .35, respectively), followed by Agreeableness ($r = .34$ and .25, respectively), and Conscientiousness ($r = .16$ and .18, respectively). Extraversion was not significantly associated with pro-environmental attitudes ($r = .06$) but was

with pro-environmental behaviors ($r = .12$). Neuroticism was not significantly associated with pro-environmental attitudes and behaviors ($r = -.01$ and $-.09$, respectively).

Within Openness, all facets were positively associated with pro-environmental attitudes and behaviors, although the strengths of these associations varied considerably between facets ($r = .14$ to .40 and .16 to .35, respectively). The one exception to this was that Imagination was not significantly associated with pro-environmental behaviors. The facet of Artistic Interests was consistently the strongest facet associated with pro-environmental attitudes and behaviors ($r = .40$ and .35, respectively).

For the facets of Conscientiousness, all associations were positive, but there was variation among them. For example, Cautiousness was not significantly associated with pro-environmental attitudes and behaviors ($r = .01$). In contrast, Self-Efficacy, Dutifulness, and Achievement Striving were associated with both pro-environmental attitudes and behaviors ($r = .13$ to .21 and .12 to .20, respectively). Orderliness and Self-Discipline were only associated with pro-environmental behaviors ($r = .13$ and .15, respectively).

The Agreeableness' facets of Morality, Altruism, Cooperation, Modesty, and Sympathy were significantly associated with pro-environmental attitudes and behaviors, but the effect sizes varied ($r = .13$ to .43 and .11 to .31, respectively; the strongest correlations were for Sympathy). Trust was not associated with pro-environmental attitudes and behaviors ($r = .04$ and .05, respectively).

Last, Extraversion's and Neuroticism's facets tended to not be associated with pro-environmental attitudes and behaviors, with a few exceptions. Extraversion's facets of Activity Level and Cheerfulness were associated with pro-environmental behaviors ($r = .14$ and .12, respectively), and Neuroticism's facet of Immoderation was negatively associated with pro-environmental behaviors ($r = -.14$).

3.2 | Comparison of traits' associations with attitudes and behaviors

Hypothesizing that pro-environmental attitudes mediate personality traits' associations with pro-environmental behaviors, we expected (a) the profiles of the former and the latter to be similar and (b) the former (more proximate) associations to be, on average, stronger than the latter. Indeed, the profiles of facets' associations with pro-environmental attitudes and behaviors were similar ($r = .88$, $p < .001$), but the absolute values of the correlations were only marginally stronger on average for pro-environmental attitudes ($r = .14$) than for pro-environmental behaviors ($r = .13$). However, it is important to note that some associations differed in direction, but this was infrequent ($N = 5$) and only for nonsignificant associations.

3.3 | Correlations-based prediction

While these correlations provided a more detailed picture of how personality was associated with pro-environmental attitudes and behaviors, they did not fully account for the over-fitting of associations in individual samples and for

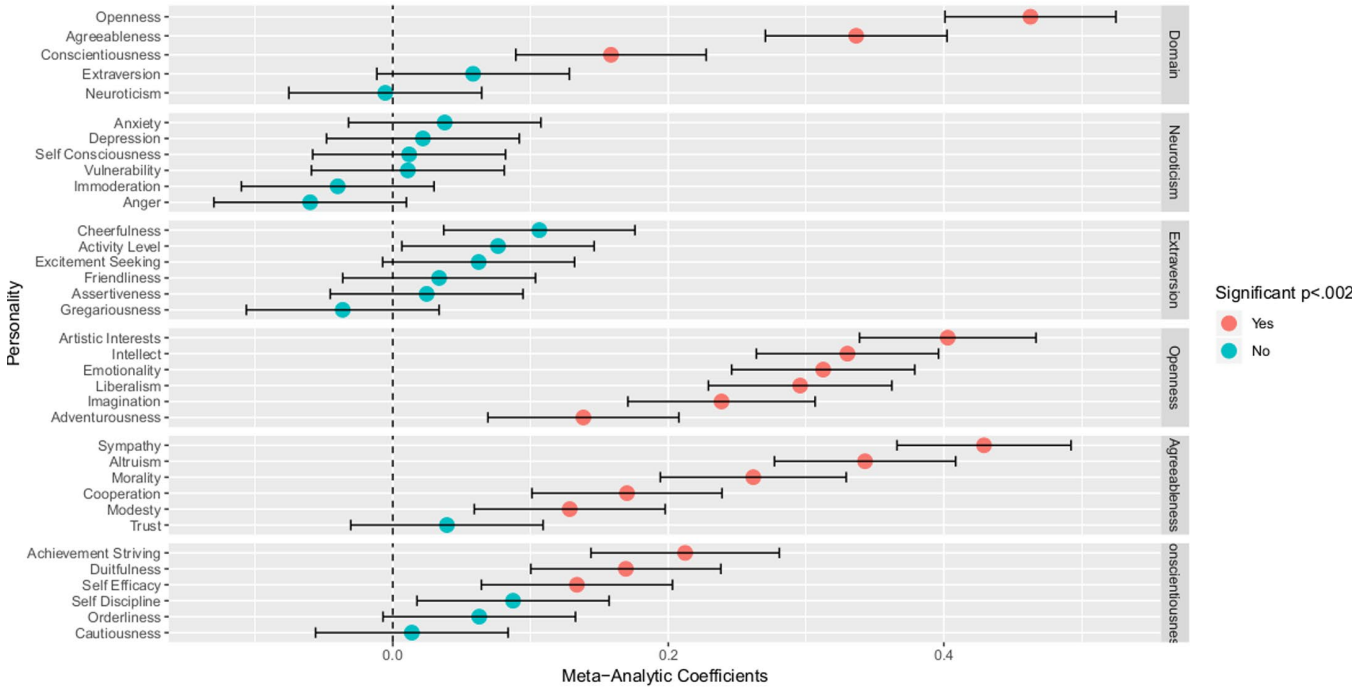

FIGURE 1 The meta-analytic associations between personality and pro-environmental attitudes

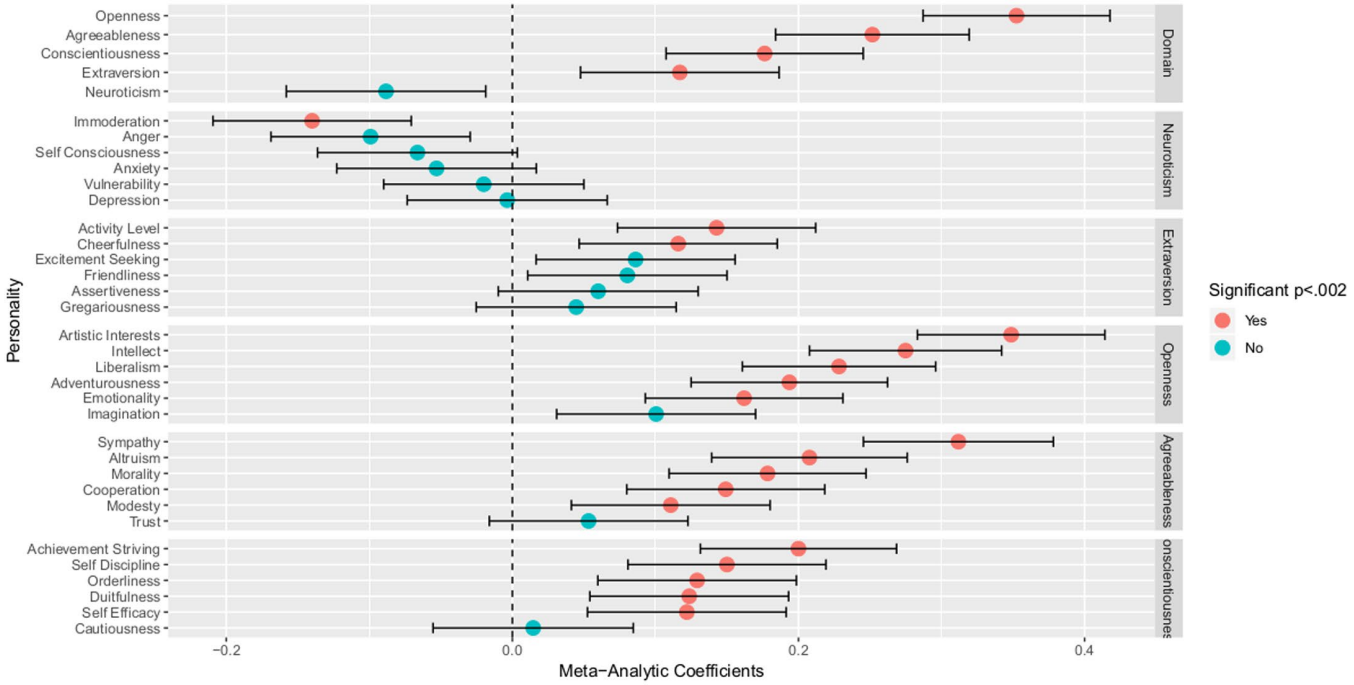

FIGURE 2 The meta-analytic associations between personality and pro-environmental behaviors

the overlaps between personality domains (and between facets), nor did they provide direct evidence of the predictive power of personality traits for outcomes (Yarkoni & Westfall, 2017). Thus, we directly examined the ability of personality domains and facets to predict pro-environmental attitudes and behaviors through the prediction analyses of "training" and "validation" models in independent datasets. This approach is standard in machine learning and had been shown to mitigate the potential effects of sampling biases, instrument biases, and some researcher degrees of freedom. Conceptually, this can be thought of as a very thorough test of the degree to which personality is associated with pro-environmental attitudes and behaviors.

The standardized domain scores, in Dataset B, were multiplied by corresponding domain correlations with either pro-environmental attitudes or behaviors (obtained from Dataset A) and subsequently summed, yielding predicted (from domains) pro-environmental attitudes and behaviors scores for each individual. These predicted scores were then correlated with the measured scores of pro-environmental attitudes and behaviors in Dataset B. This was repeated, swapping around the datasets. This was also completed for facets, replacing domains in the above steps.

It was found that the domain-level associations from Dataset A predicted pro-environmental attitudes ($r = .49$) and behaviors ($r = .28$) in Dataset B. The facet-level associations predicted pro-environmental attitudes ($r = .51$) and behaviors ($r = .29$). The domain-level associations from Dataset B predicted pro-environmental attitudes ($r = .50$) and behaviors ($r = .43$) in Dataset A. The facet-level associations predicted pro-environmental attitudes ($r = .50$) and behaviors ($r = .42$). All correlations were significant $p < .001$.

3.4 | Elastic net prediction

Dataset B contained fewer than 500 participants, which had been previously found to be the minimum required size for training via elastic net modeling (Mõttus & Rozgonjuk, 2019; Seeboth & Mõttus, 2018; Zou & Hastie, 2005). As a result, Dataset A was the "training" dataset and provided predicted pro-environmental attitudes and behaviors in Dataset B. It was found that the domain-level associations from Dataset A predicted pro-environmental attitudes ($r = .52$) and behaviors ($r = .31$) in Dataset B. The facet-level associations also predicted pro-environmental attitudes ($r = .52$) and behaviors ($r = .33$). All correlations were significant $p < .001$. Therefore, there was no evidence that facets provided incremental predictive ability over domains for either pro-environmental attitudes or behaviors, despite facets of the same domains often varying in their correlations with these outcomes.

4 | DISCUSSION

4.1 | Domains and pro-environmental attitudes and behaviors

We expected to find similar domain-level associations with pro-environmental attitudes and behaviors as found in

Soutter and colleagues (2020). This was mostly supported, as Openness was consistently and highly correlated with pro-environmental attitudes and behaviors, as were Agreeableness and Conscientiousness. Furthermore, Neuroticism was not associated with pro-environmental attitudes and behaviors. The inconsistency was that Extraversion was only associated with pro-environmental behaviors. However, the previous meta-analysis demonstrated that Extraversion had the weakest significant association with pro-environmental attitudes (Soutter et al., 2020). Thus, it might be due to this weak association that we did not replicate its association with pro-environmental attitudes in this study.

4.2 | Facets and pro-environmental attitudes and behaviors

We expected that describing personality traits at the facet-level would provide a more detailed picture of their associations with pro-environmental attitudes and behaviors. The correlations did, indeed, reveal a more detailed picture of these associations.

For Openness, although all its facets contributed to its positive association, the facet of Artistic Interests was consistently the strongest associate of pro-environmental attitudes and behaviors. This was in line with past research which had stated that aestheticism is particularly important for pro-environmental attitudes and behaviors (Markowitz et al., 2012). This facet had been argued to increase one's aesthetic appreciation of nature, which in turn motivates a desire to preserve nature (Hirsh & Dolderman, 2007). Intellect also had a comparatively strong association with pro-environmental attitudes and behaviors, which might be due to a greater understanding of the consequences humans have on the environment, which might result in a motivation to protect it. Liberalism was also comparatively strongly associated with pro-environmental attitudes and behaviors. Liberalism, in this context, is defined as a readiness to challenge authority, tradition, and convention (Johnson, 2020). This makes sense in light of environmentalism (think of Extinction Rebellion movement for an extreme example), which is often challenging the existing societal, political, and economic institutions that have contributed to the current ecological crises us, as humans, are facing. This builds upon earlier research which has suggested that unconventionality is only associated with pro-environmental attitudes, and not behaviors (Brick & Lewis, 2016). It might be that this association has altered through time, which could be reflected in the rise of worldwide movements to promote environmentalism (e.g., FridaysForFuture and Extinction Rebellion). Furthermore, it might be that the behaviors examined in this study were more in line with unconventionality as opposed to those behaviors examined by Brick and Lewis. For example, Dataset A included pro-environmental behaviors that assessed political support and protesting, whereas Brick and Lewis did not.

The facets of Agreeableness were generally associated with pro-environmental attitudes and behaviors in a positive direction, similarly to the domain. There was one exception to this, which was the facet of Trust, which was not associated with pro-environmental attitudes and behaviors. This lack of a relationship is interesting and should be probed in further research. For the other facets, Sympathy and Altruism had the strongest associations with pro-environmental attitudes and behaviors. This supported the idea that empathy and altruism are why people behave pro-environmentally (e.g., Schultz, 2001). This was also in line with past research that had suggested that facets like these were the reason why the domain of Agreeableness is associated with pro-environmental attitudes and behaviors (Markowitz et al., 2012). This makes sense as compassion and wanting to help others are needed to care for the environment, and subsequently help it. Morality and Cooperation also appeared to be associated with pro-environmental attitudes and behaviors; indeed, cooperating with others is needed to enact impactful environmental change and acting or wanting to protect those unable to help themselves (i.e., the environment) is an obvious moral goal.

The facets of Conscientiousness were also positively associated with pro-environmental attitudes and behaviors, but in a more sporadic pattern than Agreeableness' facets. Cautiousness was consistently not associated with pro-environmental attitudes and behaviors, while Self-Efficacy, Dutifulness, and Achievement Striving were consistently associated with them. Cautiousness is defined as one's disposition to think through possibilities before acting (Johnson, 2020). Thus, its lack of an association suggested that acting pro-environmentally can appeal to both those who do (not) think through their actions. Therefore, regardless of one's approach to tasks, regarding thinking through it, people can behave and think pro-environmentally. Self-Efficacy, Dutifulness, and Achievement Striving were all consistently associated with pro-environmental attitudes and behaviors, which suggested that pro-environmental individuals were goal-driven and persevere with tasks. This makes sense in the context of pro-environmental attitudes and behaviors, as combating or reducing environmental impact is a large task, which would require a desire to continue over time and situations despite setbacks, and a belief that one could do so. Interestingly Self-Discipline was only positively associated with pro-environmental behaviors. This might suggest that self-discipline is only needed to continuously perform pro-environmental behaviors and that it is not necessary for pro-environmental attitudes. However, greater research is needed into why Self-Discipline was not associated with pro-environmental attitudes.

For Extraversion, only the facets of Activity Level and Cheerfulness were significantly associated with

pro-environmental behaviors. These findings suggested that certain pro-environmental behaviors involve or are compatible with a high level of stimulation that are perhaps enjoyable, but that this does not necessarily translate to fostering more pro-environmental attitudes in people. It might be the case the individuals high in these facets engage more with outdoor activities (e.g., sports or hiking) and that this active engagement with the natural environment leads to pro-environmental behaviors.

Last, for Neuroticism the only significant result was Immoderation being negatively associated with pro-environmental behaviors. Johnson (2020) described individuals high in Immoderation as being orientated toward short-term pleasures, rather than long-term consequences. As pro-environmental behaviors often involve making sacrifices or require extra effort in the short term, to avoid a long-term consequence, it is thus logical that individuals who are orientated to avoid these short-term consequences would act un-environmentally. This provided greater insight into Neuroticism's association with pro-environmental attitudes and behaviors, which was hidden when looking at domain-level associations, which demonstrated a lack of a relationship between Neuroticism and pro-environmental attitudes and behaviors in a recent meta-analysis (Soutter et al., 2020) and here.

4.3 | On predictions

This study also aimed to examine whether this greater knowledge of facet-level associations with pro-environmental attitudes and behaviors would translate into a greater predictive ability. Two types of predictive modeling were performed, and across both, it was found that facet-level predictions were on par with domain-level predictions. The domain-level predictions were in a similar range to those found in Soutter and colleagues (2020). The facet-level predictions were also comparable to those found by Soutter and colleagues for domains. This evidence suggested that despite facet-level information having provided a greater understanding of personality's associations with pro-environmental attitudes and behaviors, this did not translate into a greater out-of-sample predictive ability. This was in contrast with other findings in the literature regarding other outcomes (e.g., Elleman, Condon et al., 2020; Elleman, McDougald et al., 2020; Mõttus & Rozgonjuk, 2019).

One reason for this might be that that the domain-level predictions were already quite high, thus any marginal facet differences may not translate to better predictions; unlike for many other outcomes (e.g., Mõttus, 2016). Another reason may be that our samples were not sufficiently large to yield stable enough training models for out-sample prediction; with larger samples, some gains in facet-level prediction over domain-level prediction might be possible, although our current findings suggested that the gains would unlikely be huge.

4.4 | Limitations and generalizability

While this study demonstrated that facets provided greater information on personality's associations with pro-environmental attitudes and behaviors and provided substantial predictive accuracy for these attitudes and behaviors, there were several issues that might have impacted the generalizability of these findings. First, the pool of facets we examined was solely from the IPIP-NEO-120. While having a consistent measure of personality across datasets is useful for analytical purposes, it is a restriction of the possible facets examined. For one it restricted facets to just the Big Five and ignored the facets of the HEXACO model of personality. Thus, this study could only make claims about the Big Five facets, and not those of the HEXACO. Furthermore, the number and type of facets for each domain are not consistent and changes between measures of the Big Five (DeYoung, 2014). Future research should collect data from a wider set of personality measures to better understand if these facet-level associations are consistent across the Big Five and HEXACO, at least for similarly named facets, and whether this present study missed any important facets that could be associated with pro-environmental attitudes and behaviors. Also, future research should consider narrower-still personality traits, nuances (McCrae, 2015; Mõttus, 2016; Mõttus, Kandler, Bleidorn, Riemann, & McCrae, 2017; Mõttus et al., 2019), which often provide the strongest predictive power (e.g., Elleman, Condon et al., 2020; Elleman, McDougald et al., 2020; Seeboth & Mõttus, 2018).

Second, there were potential issues with our samples. Both datasets relied on internet recruitment, with Dataset B also including first-year undergraduate students. Thus, the samples we assessed here were unlikely to be representative of the general population. For example, our samples were predominantly female and skewed toward a younger age. Furthermore, although data on education was not collected for Dataset A, 81.1% of our sample in Dataset B had at least some higher education, thus even if everyone in Dataset A had no higher education over half our total sample had some higher education. Lastly, the study was restricted to those who had access to the internet and time to complete an online survey. Thus, there might be some limit to the generalizability of these findings to the general population. Furthermore, our sample sizes were relatively small; this was especially an issue for predictive modeling. Due to low sample sizes, we were unable to consider personality nuances, which had been shown to provide even greater information on associations than facet-level analysis (e.g., Mõttus & Rozgonjuk, 2019).

Last, the datasets used within these studies exclusively focused on self-report measures of pro-environmental behaviors. While this is a common method of assessment regarding pro-environmental behaviors (Steg & Vlek, 2009), there are some questions regarding the validity of these self-reports (Gifford, 2014; Lange, Steinke, & Dewitte, 2018). A meta-analysis had found a large association between self-reported and actual objective pro-environmental behaviors ($r = .46$), but it was argued that this is functionally small (Kormos & Gifford, 2014). Thus, if researchers wish for their work to have a practical application in addressing humanity's impact on the natural environment, a greater focus on actual objective pro-environmental behaviors is required. For a review on measuring pro-environmental behaviors see Lange and Dewitte (2019).

4.5 | Going forward

As research in understanding how facets are associated with pro-environmental attitudes and behaviors is in its infancy the weaknesses of this study were to be expected, and greater research will be needed in this area. However, this study provided an exploratory insight into whether facets provided a greater understanding of personality's association with pro-environmental attitudes and behaviors. Unlike domain-level research, facet-level research in this field is very limited, with a literature search, and the results of Soutter and colleagues (2020) having revealed only six studies that examined facet-level associations explicitly. While some studies might have been missed, this is clearly a fraction of the research done at a domain-level (59 studies identified in Soutter et al., 2020). Furthermore, of these studies, none had attempted to examine whether facets predicted pro-environmental attitudes and behaviors, or if it did this to a greater extent than domains.

While more research in this area is needed, a greater understanding of what facets drive domain-level associations can provide valuable insight into tailoring successful interventions. For example, this study demonstrated that Agreeableness as a domain was positively associated with pro-environmental attitudes and behaviors. Within this domain, Sympathy and Altruism were the primary drivers of this association. Thus, as individuals low in these facets are unlikely to engage in pro-environmental behaviors, interventions should not attempt to motivate action through compassionate means. Instead, campaigns should attempt to motivate action through focusing on the direct benefits of acting pro-environmentally (e.g., reduction in electricity bills or schemes that financially reward recycling e.g., bottle return schemes), as it is likely individuals who are compassionate are already acting environmentally, and those who are low in these traits are unlikely to be swayed by interventions that use these motivations.

4.6 | Conclusion

In conclusion, this study examined whether facets, over the Big Five domains, provided a greater understanding of personality traits' associations with pro-environmental attitudes and behaviors. We found that examining personality at a facet-level provided information on which facets were the strongest contributors to domains' associations with pro-environmental attitudes and behaviors. Furthermore, the data suggested that facet-level information provided equal predictive ability to that of domain-level information. While this study had several limitations, it provided a useful start to research on better understanding of personality's association with pro-environmental attitudes and behaviors.

ACKNOWLEDGMENTS

This work was funded by PhD grants provided by the school of Philosophy, Psychology, and Language Sciences (PPLS) at the University of Edinburgh. The authors declare that the funding body had no influence over any components of this paper or research. The data used in this study received ethics approval from the PPLS Research Ethics Committee, University of Edinburgh. Datasets and R scripts used in this study can be found as Supporting Information to this paper on the Open Science Framework (https://osf.io/6c37n/?view_only=26cf482b7241440898e70a3f57ceb353).

CONFLICT OF INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ORCID

Alistair Raymond Bryce Soutter https://orcid.org/0000-0001-5679-926X
René Mõttus https://orcid.org/000-0002-6403-5224

REFERENCES

Ashton, M. C., & Lee, K. (2007). Empirical, theoretical, and practical advantages of the HEXACO model of personality structure. *Personality and Social Psychology Review*, *11*(2), 150–166. https://doi.org/10.1177/1088868306294907

Ashton, M. C., & Lee, K. (2020). Objections to the HEXACO model of personality structure—And why those objections fail. *European Journal of Personality*. https://doi.org/10.1002/per.2242

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, *27*(1), 14–25. https://doi.org/10.1016/j.jenvp.2006.12.002

Boeve-de Pauw, J., Donche, V., & Van Petegem, P. (2011). Adolescents' environmental worldview and personality: An explorative study. *Journal of Environmental Psychology*, *31*(2), 109–117. https://doi.org/10.1016/j.jenvp.2010.05.003

Brick, C., & Lewis, G. J. (2016). Unearthing the "green" personality: Core traits predict environmentally friendly behavior. *Environment and Behavior*, *48*(5), 635–658. https://doi.org/10.1177/0013916514554695

Clayton, S., & Brook, A. (2005). Can psychology help save the world? A model for conservation psychology. *Analyses of Social Issues and Public Policy*, *5*(1), 87–102. https://doi.org/10.1111/j.1530-2415.2005.00057.x

Condon, D. M. (2018, January 10). *The SAPA Personality Inventory: An empirically-derived, hierarchically-organized self-report personality assessment model*. PsyArXiv. https://doi.org/10.31234/osf.io/sc4p9

Costa, P. T. Jr., & McCrae, R. R. (1992). *Revised NEO personality inventory (NEO-PI-R) and NEO five-factor (NEO-FFI) inventory professional manual*. Odessa, FL: Psychological Assessment Resources.

DeYoung, C. G. (2014). Cybernetic Big Five theory. *Journal of Research in Personality*, *56*, 33–58. https://doi.org/10.1016/j.jrp.2014.07.004

Diessner, R., Davis, L., & Toney, B. (2009). Empirical relationships between beauty and justice: Testing Scarry and elaborating Danto. *Psychology of Aesthetics, Creativity, and the Arts*, *3*(4), 249–258. https://doi.org/10.1037/a0014683

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of the New Ecological Paradigm: A revised NEP scale. *Journal of Social Issues*, *56*(3), 425–442. https://doi.org/10.1111/0022-4537.00176

Elleman, L. G., Condon, D. M., Holtzman, N. S., Allen, V. R., & Revelle, W. (2020, February 15). *Smaller is better: Associations between personality and demographics are improved by examining narrower traits and regions*. PsyArXiv. https://doi.org/10.31234/osf.io/dpmg2

Elleman, L. G., McDougald, S. K., Condon, D. M., & Revelle, W. (2020, February 26). *That takes the BISCUIT: A comparative study of predictive accuracy and parsimony of four statistical learning techniques in personality data, with data missingness conditions*. PsyArXiv. https://doi.org/10.31234/osf.io/tuqap

Friedman, J., Hastie, T., Simon, N., & Tibshirani, R. (2019). glmnet: Lasso and Elastic-Net Regularized Generalized Linear Models (Version 3.0-2). Retrieved from http://cran.r-project.org/web/packages/glmnet/index.html

Gifford, R. (2014). Environmental psychology matters. *Annual Review of Psychology*, *65*(1), 541–579. https://doi.org/10.1146/annurev-psych-010213-115048

Goldberg, L. R. (1990). An alternative "description of personality": The Big-Five factor structure. *Journal of Personality and Social Psychology*, *59*(6), 1216–1229. https://doi.org/10.1037/0022-3514.59.6.1216

Hawcroft, L. J., & Milfont, T. L. (2010). The use (and abuse) of the New Environmental Paradigm scale over the last 30 years: A meta-analysis. *Journal of Environmental Psychology*, *30*(2), 143–158. https://doi.org/10.1016/j.jenvp.2009.10.003

Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *The Journal of Environmental Education*, *18*(2), 1–8. https://doi.org/10.1080/00958964.1987.9943482

Hirsh, J. B. (2010). Personality and environmental concern. *Journal of Environmental Psychology*, *30*(2), 245–248. https://doi.org/10.1016/j.jenvp.2010.01.004

Hirsh, J. B. (2014). Environmental sustainability and national personality. *Journal of Environmental Psychology*, *38*, 233–240. https://doi.org/10.1016/j.jenvp.2014.02.005

Hirsh, J. B., & Dolderman, D. (2007). Personality predictors of consumerism and environmentalism: A preliminary study. *Personality and Individual Differences*, *43*(6), 1583–1593. https://doi.org/10.1016/j.paid.2007.04.015

Johnson, J. A. (2014). Measuring thirty facets of the Five Factor Model with a 120-item public domain inventory: Development of the IPIP-NEO-120. *Journal of Research in Personality*, *51*, 78–89. https://doi.org/10.1016/j.jrp.2014.05.003

Johnson, J. A. (2020). *Descriptions used in IPIP-NEO narrative report*. Retrieved from http://www.personal.psu.edu/faculty/j/5/j5j/IPIPNEOdescriptions.html

Klein, R. M. (2015). *Employee motives for engaging in environmentally sustainable behaviors: A multi-study analysis* (Doctoral dissertation). University of Minnesota. Retrieved from https://conservancy.umn.edu/bitstream/handle/11299/191323/Klein_umn_0130E_16481.pdf?sequence=1&isAllowed=y

Klein, S. A., Heck, D. W., Reese, G., & Hilbig, B. E. (2019). On the relationship between Openness to Experience, political orientation, and pro-environmental behavior. *Personality and Individual Differences*, *138*, 344–348. https://doi.org/10.1016/j.paid.2018.10.017

Kormos, C., & Gifford, R. (2014). The validity of self-report measures of proenvironmental behavior: A meta-analytic review. *Journal of Environmental Psychology*, *40*, 359–371. https://doi.org/10.1016/j.jenvp.2014.09.003

Lange, F., & Dewitte, S. (2019). Measuring pro-environmental behavior: Review and recommendations. *Journal of Environmental Psychology*, *63*, 92–100. https://doi.org/10.1016/j.jenvp.2019.04.009

Lange, F., Steinke, A., & Dewitte, S. (2018). The pro-environmental behavior task: A laboratory measure of actual pro-environmental behavior. *Journal of Environmental Psychology*, *56*, 46–54. https://doi.org/10.1016/j.jenvp.2018.02.007

Lee, K., Ashton, M. C., Choi, J., & Zachariassen, K. (2015). Connectedness to nature and to humanity: Their association and personality correlates. *Frontiers in Psychology*, *6*, 1–11. https://doi.org/10.3389/fpsyg.2015.01003

Markle, G. L. (2013). Pro-environmental behavior: Does it matter how it's measured? Development and validation of the Pro-Environmental Behavior Scale (PEBS). *Human Ecology*, *41*(6), 905–914. https://doi.org/10.1007/s10745-013-9614-8

Markowitz, E. M., Goldberg, L. R., Ashton, M. C., & Lee, K. (2012). Profiling the "pro-environmental individual": A personality perspective. *Journal of Personality*, *80*(1), 81–111. https://doi.org/10.1111/j.1467-6494.2011.00721.x

Mayer, F. S., & Frantz, C. M. (2004). The Connectedness to Nature Scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, *24*(4), 503–515. https://doi.org/10.1016/j.jenvp.2004.10.001

McCrae, R. R. (2015). A more nuanced view of reliability: Specificity in the trait-hierarchy. *Personality and Social Psychology Review*, *19*(2), 97–112. https://doi.org/10.1177/1088868314541857

McCrae, R. R., & John, O. P. (1992). An introduction to the Five-Factor model and its applications. *Journal of Personality*, *60*(2), 175–215. https://doi.org/10.1111/j.1467-6494.1992.tb00970.x

Milfont, T. L. (2007). *Psychology of environmental attitudes: A cross-cultural study of their content and structure* (PhD dissertation). Retrieved from https://researchspace.auckland.ac.nz/bitstream/handle/2292/1712/02whole.pdf?sequence=5

Milfont, T. L., & Sibley, C. G. (2012). The Big Five personality traits and environmental engagement: Associations at the individual and

societal level. *Journal of Environmental Psychology*, *32*(2), 187–195. https://doi.org/10.1016/j.jenvp.2011.12.006

Mõttus, R. (2016). Towards more rigorous personality trait-outcome research. *European Journal of Personality*, *30*(4), 292–303. https://doi.org/10.1002/per.2041

Mõttus, R., Kandler, C., Bleidorn, W., Riemann, R., & McCrae, R. R. (2017). Personality traits below facets: The consensual validity, longitudinal stability, heritability, and utility of personality nuances. *Journal of Personality and Social Psychology: Personality Processes and Individual Differences*, *112*(3), 474–490. https://doi.org/10.1037/pspp0000100

Mõttus, R., & Rozgonjuk, D. (2019). Development is in the details: Age differences in the Big Five domains, facets and nuances. *Journal of Personality and Social Psychology*. Advance online publication. https://doi.org/10.1037/pspp0000276

Mõttus, R., Sinick, J., Terracciano, A., Hřebíčková, M., Kandler, C., Ando, J., … Jang, K. L. (2019). Personality characteristics below facets: A replication and meta-analysis of cross-rater agreement, rank-order stability, heritability, and utility of personality nuances. *Journal of Personality and Social Psychology: Personality Processes and Individual Differences*, *117*(4), e34–e50. https://doi.org/10.1037/pspp0000202

Paunonen, S. V., & Ashton, M. C. (2001). Big Five factors and facets and the prediction of behavior. *Journal of Personality and Social Psychology*, *81*(3), 524–539. https://doi.org/10.1037//0022-3514.81.3.524

Pettus, A. M., & Giles, M. B. (1987). Personality characteristics and environmental attitudes. *Population and Environment*, *9*(3), 127–137. Retrieved from https://link.springer.com/content/pdf/10.1007/BF01259303.pdf

Puech, C., Dougal, J., Deery, C., Waddell, C., & Mõttus, R. (2019). Openness is related to proenvironmental behavior both within and across families. *Environment and Behavior*. https://doi.org/10.1177/0013916519853294

R Core Team. (2019). *The R project for statistical computing*. Retrieved from https://www.r-project.org/

Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, *21*(4), 327–339. https://doi.org/10.1006/jevp.2001.0227

Seeboth, A., & Mõttus, R. (2018). Successful explanations start with accurate descriptions: Questionnaire items as personality markers for more accurate predictions. *European Journal of Personality*, *32*(3), 186–201. https://doi.org/10.1002/per.2147

Soto, C. J., & John, O. P. (2017). The next Big Five Inventory (BFI-2): Developing and assessing a hierarchical model with 15 facets to enhance bandwidth, fidelity, and predictive power. *Journal of Personality and Social Psychology*, *113*(1), 117–143. https://doi.org/10.1037/pspp0000096

Soutter, A. R. B. (2020). *Pro-environmental attitudes and behaviours: The role of individual differences* (Unpublished PhD dissertation). Edinburgh, Scotland: The University of Edinburgh.

Soutter, A. R. B., Bates, T. C., & Mõttus, R. (2019). *Associations of imagery and personality to pro-environmental attitudes and behaviours* (Unpublished manuscript).

Soutter, A. R. B., Bates, T. C., & Mõttus, R. (2020). Big Five and HEXACO personality traits, proenvironmental attitudes, and behaviors: A meta-analysis. *Perspectives on Psychological Science*, *15*(4), 913–941. https://doi.org/10.1177/1745691620903019

Soutter, A. R. B., & Boag, S. (2019). Environmental advertising: The effect of imagery on pro-environmental attitudes and pro-environmental behaviour/Publicidad medioambiental: el efecto de las imágenes sobre las actitudes proambientales y el comportamiento proambiental. *Psycecology*, *10*(1), 88–126. https://doi.org/10.1080/21711976.2018.1550238

Soutter, A. R. B., & Mõttus, R. (2019). *Political beliefs, personality, and environmentalism*. Manuscript in preparation. Edinburgh, UK: Department of Psychology, University of Edinburgh.

Soutter, A. R. B., & Mõttus, R. (2020). *Data files for Big Five facets' associations with pro-environmental attitudes and behaviors* [Data set]. https://doi.org/10.17605/OSF.IO/6C37N

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Vainik, U., Dagher, A., Realo, A., Colodro-Conde, L., Mortensen, E. L., Jang, K., … Mõttus, R. (2019). Personality-obesity associations are driven by narrow traits: A meta-analysis. *Obesity Review*, *20*(8), 1121–1131. https://doi.org/10.1111/obr.12856

White, K. M., & Hyde, M. K. (2012). The role of self-perceptions in the prediction of household recycling behavior in Australia. *Environment and Behavior*, *44*(6), 785–799. https://doi.org/10.1177/0013916511408069

Yarkoni, T., & Westfall, J. (2017). Choosing prediction over explanation in psychology: Lessons from machine learning. *Perspectives on Psychological Science*, *12*(6), 1100–1122. https://doi.org/10.1177/1745691617693393

Zou, H., & Hastie, T. (2005). Regularization and variable selection via elastic net. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, *67*(2), 301–320. https://doi.org/10.1111/j.1467-9868.2005.00503.x

How to cite this article: Soutter ARB, Mõttus R. Big Five facets' associations with pro-environmental attitudes and behaviors. *Journal of Personality*. 2020;00:1–13. https://doi.org/10.1111/jopy.12576